

## APPENDIX A



### Description

## A Syntactic Query Engine

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## TABLE OF CONTENTS

1	Abstract .....	3
2	Technical Background.....	4
2.1	Syntactic Indexing Framework.....	4
2.1.1	Parser Technology.....	4
2.1.2	Smart Syntactic Structures .....	5
2.1.3	Elementary Coreferencing Rules.....	6
2.1.4	Storage and Access.....	10
2.2	Operations on Data Structures.....	10
2.2.1	Syntax Operators, Similarity Metrics and Robust Coreferencing .....	10
3	Implementation .....	14
3.1	Syntactic Queries on Medline Abstracts .....	14

## 1 Abstract

The techniques described herein are used to create a Syntactic Query Engine that provides enhanced document indexing as well as syntactic-based searches. The approach comprises the following four steps:

### INDEXING

1. Existing parsing technology is adapted to output an abstract representation for sentences that is suitable for cross-document indexing. A central idea is to collapse selected nodes in a full linguistic parse tree into a simpler dependency structure that also captures more valuable information through field redundancy
2. Smart indexing structures are created for storing, searching and manipulating sentence structures. The dependency structures output by the modified parser are stored in sets of disjoint clustered tables, each storing the same "pair" of syntactic relationships detected across a large corpus.

### SEARCH

3. New search operators are developed based on the indexing structures described above. These include structured searches where keywords can be constrained to obey a precise syntactic role, such as subject, object, governing verb of a sentence, preposition or verb modifier. A methodology for sentence similarity searching is also implemented.
4. A new Graphical User Interface (GUI) concept for browsing the results of the syntactic search has been developed. This GUI introduces a new paradigm for search engines. First, it allows the user to specify the syntactic role that keywords in the input query must obey. For instance, the user may enter the keywords "Bill Clinton" with the constraint that these keywords must be the governing subjects of an action or sentence. Second, it allows three levels of progressive information discovery, corresponding to three successive screen views. At the first level, the GUI displays a list of all actions (verbs or verb phrases) found in a large corpus of documents that obey the query constraints. Using the above example, these actions could be a list of the following keywords: *win, speak, travel to, rule, lie, deny, address, etc.* This list gives the user a birdseye view of all possible actions and involvements of the entity or object about which he or she is seeking information. Each of the verbs or actions in the list is automatically linked (*e.g.*, using a hyperlink or other linking technique) to a sentence that describes the complete relationship. At the second level, the user can select any of these actions and view a complete list of sentences for each action. Each of the sentences is in turn linked with the full text of the document. At the third level, the user can select any of these sentences and view the sentence in the context of the full document.

## 2 Technical Background

The notion of “document as a bag of sentences” indexing rests on the principles of linguistic normalization. Linguistic normalization maps semantically equivalent sentences into one canonical sentence representation. It operates at three levels: morphological, semantic and syntactic. Morphological normalization is usually referred to as stemming or conflation. Semantic normalization involves recognition of keyword relationships such as synonyms, antonyms and meronyms. Syntactic normalization may involve transformational rules that recognize the semantic equivalence of different phrase structures.

The enhanced indexing and search technology described herein encompasses proprietary algorithms for morphological, semantic and syntactic modeling of languages. A strength of this approach is that the models are statistical in nature, and can be adapted to cross-lingual and even multimedia data dimensions. For instance, for morphological normalization, a conflation technique has been developed based on the statistics of n-grams. A weighted similarity measure is used to produce a similarity matrix that is clustered via hierarchical agglomerative clustering methods. This morphological model is language independent and robust to OCR and speech recognition errors. As such it can be applied to the output of an ASR system operating, for example, on a video audio track.

### 2.1 Syntactic Indexing Framework

#### 2.1.1 Parser Technology

The enhanced indexing and search technology is being used to develop commercial Q&A solutions (*e.g.*, a Syntactic Query Engine) based on a variety of parsing technologies. These include: 1) principle based parsing and 2) stochastic parsing. Minipar (D. Lin, 1993) is an example of the first. It is a principle-based parser. Unlike rule-based grammars, which tend to produce a large number of rules to describe specific language patterns, Minipar is based on more fundamental and universal principles based on the government-binding theory (Chomsky, 1981). It achieves a relatively small number of candidate syntactic structures by applying principles to descriptions of the structures rather than to the structures themselves. Minipar carries out the parsing through an efficient message-passing algorithm. A stochastic parser is also being developed based on the Structured Language Model (SLM) conceived by C. Chelba and F. Jelinek (2000). The key features of this parser are its capacity to model and handle context dependence, its flexibility, and its computational tractability. For example, the parser has the capability of deciding part of speech and governor phrases for each term in a sentence, based on a search over the whole sentence. Hence the decisions are context-dependent as opposed to decisions made by parsers that just look at a limited history (terms preceding the particular term in the sentence) of each term, such as parsers based on hidden Markov models (HMM) (*i.e.* stochastic linear grammars). The parsing structure output by the parser can be represented by a binary tree. This offers a computational advantage, making the parsing algorithm tractable in a similar way to stochastic parsers based on context-free grammars. EM-type (Estimation-Maximization) re-estimation formulas (such as those used in HMM), can be derived to ease training of the parser parameters. Also,

solutions based on sub-optimal parsing strategies, such as Monte Carlo techniques, are being developed, that speed up the search for the most likely parsing of a given sentence. Functionality from multiple parsers may be incorporated into a more robust product, and the rule-based grammar approach may be extended to a number of other languages.

A parser labels every word of every sentence in every document as follows:

<term, part-of-speech, dependency-relation-with-head, head-term, document#, sentence#>

where:

term= word (stemmed or root word)

part-of-speech (pos) = noun, verb, adjective, etc.

head= term

dependency-relation-with-head= syntactic relationship between head and term.

e.g. modifier, noun-noun, subject, object.

Document # = document identifier

Sentence # = sentence number within the document #

Each record defines a node of a hierarchical tree structure of the kind shown in Figure 1.

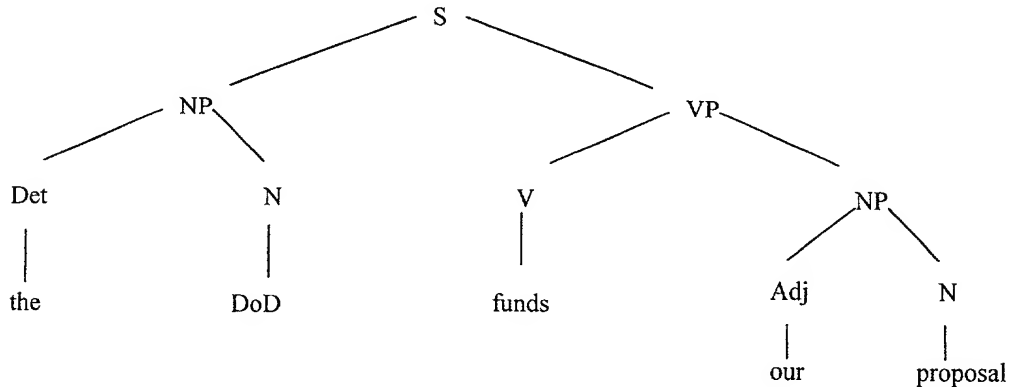


Figure 1: A phrase structure tree

The Syntactic Query Engine reconstructs augmented parse trees by joining all records from a single sentence. However, this structure does not provide efficient information access. This complex output is reduced to a “fact database” by collapsing information in the subject, verb and object categories into two relational tables. In deriving the subject-verb-object triplets the Syntactic Query Engine discards noun modifiers that have little or no semantic value.

### 2.1.2 Smart Syntactic Structures

As previously stated, a full linguistic parse tree does not lead to a tractable syntactic indexing scheme for cross-document analysis. The enhanced indexing and search techniques provide a set of rules for converting an augmented tree representation into a more robust and scalable data structure. The basic idea involves collapsing selected nodes

to reduce the complexity of the dependency structures. Through government-binding principles, a sentence can be described by a set of triplets of the form [head-term, term, relation], where term is a word in the sentence, head-term is the word's governor word, and relation specifies the particular syntactic relation binding the term to its head-term. Certain triplets are more informative than others in the sense that they by themselves convey most of a sentence message content. Among these triplets, triplets of the form [head is verb, term is noun/adjective, term is bound to the main subject of the verb], [head is verb, term is noun/adjective, term is bound to the object of the verb], or [head is verb+preposition, term is noun/adjective, term is bound to the preposition following the verb] are singled out. The last triplets are useful in answering queries regarding location (via the prepositions in, on, by, over, etc.), description (e.g. as), association (e.g. with, of), direction (e.g. to, from), time (e.g. after, before), purpose (e.g. for), etc. Other triplets are also relevant, such as those linking subject and objects directly: [noun A, noun B, term A and term B are connected through a verb as subject-object]. Even though these last triplets may not seem relevant within a sentence, they could potentially solve for ambiguities within a document. Also, when no verbs are present in the text (e.g. a title) triplets of the form [head is noun term, term is noun/adjective, noun term governs noun/adjective term] convey most of the relevant information.

The enhanced indexing and search techniques extract these triplets from a parser's output for a sentence, by introducing rules that act on the full parse tree for that sentence. First, the governing verb(s) in the sentence is (are) identified. For each verb (or verbal form) in the sentence, direct links representing the subject or the object associated to the verb are identified. Then, all terms that are indirectly and eventually bound either to the subject or to the object are identified. This search is not straightforward. Sentences phrased in passive-voice style, or with several clauses in them, are particularly difficult. Also, prepositions do not always immediately follow the verb; sometimes they even appear earlier than their associated verbs. These cases, as well as many others, are detected by traversing the parsing tree structure, and keeping records of the relative node position of the terms in the tree (e.g. node at the same height of the tree might be related to the same verb). Several terms may be eventually bound to both the subject and the object through the same verb. Additional rules are applied to filter intervening or contradictory triplets and non-diagnostic parts of speech. Finally, the transformed output from a single sentence is stored into a set of disjoint tables. These tables may be queried at a later time, by means of join and merge operators

### 2.1.3 Elementary Coreferencing Rules

The enhanced indexing and search techniques are usually able to bind pronouns (e.g., "it", "that", "them") to their "antecedent", since parsers frequently capture antecedents. The following example serves as an illustration. Consider the sentence "African bees attack humans that provoke them", and an example parsing tree associated to it (as output by Minipar):

```
E1  ( ()  fin C  *  )
1    (African  ~ A  2    mod  (gov bee))
2    (bees bee N 3    s    (gov attack))
```

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```

3  (attack ~ V_N_N E1 i (gov fin))
E3  (( bee N 3 subj (gov attack) (antecedent 2))
4  (humans human N 3 obj (gov attack))
E0  (( fin C 4 rel (gov human))
5  (that ~ THAT E0 whn (gov fin) (antecedent 4))
6  (provoke ~ V_N_N E0 i (gov fin))
E4  (( that THAT 6 subj (gov provoke) (antecedent 4))
7  (them ~ N 6 obj (gov provoke))

```

There are two terms whose antecedents need to be found. They are "that" and "them". The first term, "that", is the subject of "provoke". Here its antecedent is given by the parser. However, if this were not the case (as might occur with more complex sentences), the antecedent could easily be obtained by noticing that the clause associated with "that", hangs directly under the parent node, "humans". Hence, "humans" is the corresponding antecedent. The antecedent of the second term "them" is more difficult to elucidate. First it is the subject of "provoke", hence it cannot co-refer "humans" since this term is the subject of "provoke". Hence, nouns that are not bound to the term "humans" are determined among those found in the immediate precedent clause. In this case the only such noun is "bees", so this is the corresponding antecedent. Co-referencing in a document is similarly done. The ordered sequence of paragraphs is seen as a linear tree, where each node represents a paragraph, and each paragraph is headed by the preceding one. The first paragraph is headed by a symbolic root node (the document). Each paragraph node is similarly decomposed as a linear tree formed by the nested parsing trees of all sentences within the paragraph. The main idea is to see sentences within a single paragraph as consecutive "clauses" which are nested one after the other. These nested parsing trees form an unbalanced paragraph parsing tree that is heavier to its right. Co-reference is solved for as it would be solved for in a single parse tree.

Table 1 is an example set of data structures employed in an example implementation of sentence decomposition for a prototype collection of documents. The table entries correspond to the first four sentences of the same abstract. All four tables are incremented with parsed information from additional abstracts. The prototype collection involved 50,000 abstracts and the implementation supported the scalability of the approach to large collections.

Table 1

Subjects Table

Subject	Verb	DocID	SentenceID
cervical	be	20450337	1
Spondylotic	be	20450337	1
Myelopathy	be	20450337	1
aging	result	20450337	2
Process	result	20450337	2
Degenerative	cause	20450337	2
Change	cause	20450337	2
Cervical	cause	20450337	2
Spine	cause	20450337	2
Symptom	develop	20450337	3
differential	include	20450337	4
Diagnosis	include	20450337	4

Objects Table

Verb	Object	DocID	SentenceID
be	cause	20450337	1
be	the most	20450337	1
be	common	20450337	1
be	spinal cord	20450337	1
be	dysfunction	20450337	1
be	older	20450337	1
be	person	20450337	1
cause	compression	20450337	2
cause	spinal cord	20450337	2
develop	insidiously	20450337	3
characterize	symptom	20450337	3
include	condition	20450337	4
include	myelopathy	20450337	4
include	multiple sclerosis	20450337	4
include	amyotrophic	20450337	4
include	lateral	20450337	4
include	sclerosis	20450337	4
include	masses	20450337	4
include	metastatic tumor	20450337	4
include	spinal cord	20450337	4
press	metastatic tumor	20450337	4



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VerbModifier Table

Verb	Preposition	VerbModifier	DocID	SentenceID
result	in	degenerative	20450337	2
result	in	change	20450337	2
result	in	spine	20450337	2
result	in	advanced	20450337	2
result	in	stage	20450337	2
result	in	compression	20450337	2
result	in	spinal cord	20450337	2
cause	in	advanced	20450337	2
cause	in	stage	20450337	2
characterize	by	neck	20450337	3
characterize	by	stiffness	20450337	3
characterize	by	arm	20450337	3
characterize	by	pain	20450337	3
characterize	by	numbness	20450337	3
characterize	by	hand	20450337	3
characterize	by	weakness	20450337	3
characterize	by	leg	20450337	3
result	in	myelopathy	20450337	4
result	such as	multiple sclerosis	20450337	4
press	on	spinal cord	20450337	4

Sentence Table

Sentence	DocID	SentenceID
Cervical spondylotic myelopathy is the most common cause of spinal cord dysfunction in older persons	20450337	1
The aging process results in degenerative changes in the cervical spine that, in advanced stages, can cause compression of the spinal cord	20450337	2
Symptoms often develop insidiously and are characterized by neck stiffness, arm pain, numbness in the hands, and weakness of the hands and legs	20450337	3
The differential diagnosis includes any condition that can result in myelopathy, such as multiple sclerosis, amyotrophic lateral sclerosis and masses (such as metastatic tumors) that press on the spinal cord	20450337	4

### 2.1.4 Storage and Access

Using the enhanced search and indexing techniques, the Syntactic Query Engine stores the modified parser output as sets of disjoint tables of similar syntactic primitives. For the sake of simplicity, an example is presented with a set of relational database tables that store only three types of coarse syntactic relationships: 1) subject-verb; 2) verb-object; and 3) verb-preposition-verbModifier. (Any number of other syntactic relationships could be stored.) Correspondingly, the output includes a: 1) *subjects table* configured as {Subject, Verb, SentenceID, DocID}; 2) *objects table* configured as {Verb, Object, SentenceID, DocID}; 3) *verb modifiers table* configured as {Verb, Preposition, VerbModifier, SentenceID, DocID}; 4) *sentence table*, configured as {SentenceID, DocID}. Indices are built for each table. For instance, (1) has two indices: the first based on *Subject*, the second on *DocID* and *SentenceID*; (3) has three indices: the first based on *Verb*, the second on *VerbModifier*, and the third on *DocID* and *SentenceID*.

The output from each sentence is used to populate all three tables, each table storing the same type of syntactic relationship across a corpus. Table 1 shows an example of a possible sentence decomposition for a single Medline abstract. Note that redundancy is introduced by collapsing terms and prepositional phrases that are bound to the object and subject category into a single category. This means that more than one object or subject entity may be associated with the same governing verb of a sentence. However, the ambiguity can be resolved with a join or merge operation of a *subjects table* with an *objects table*. For instance, a union of these two tables based on the verb “cause” and the object “compression” AND/OR “spinal cord” would produce the following answer for subject: “degenerative change cervical spine”. The prototype implementation of the Syntactic Query Engine applied to a subset of 50,000 Medline abstracts indicates that this redundancy does not appear to compromise performance substantially (< 0.1 sec for 5 nested joins across the full set of tables for the entire database), but increases the robustness of the data bank. These storage structures also address the difficult problem of co-referencing or tracking entities in a single document or phrase. In this implementation, data is stored based on the key of the most frequently used index. This enables fast data retrieval from disk as all data is stored in the neighboring disk blocks. In order to solve performance problems related to incremental indexing and improve scalability even more, modified database schemas and key sorting methods based on clustered tables, hash clusters, binary or R-trees may be used.

## 2.2 Operations on Data Structures

### 2.2.1 Syntax Operators, Similarity Metrics and Robust Co-referencing

The modified parser output or triplet representation relies on the identification of the governing verb of a sentence, and is verb centric. Verbs or actions govern subjects and objects. The smart structures introduced above support global search operators that can be used to profile the syntactic role of named entities across a document collection. Returning to the 50,000 Medline abstracts, the database could be queried for all subject or object roles of an entity, say “CB1” (Figure 2). The columns show the governing verbs or

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actions that are bound to “CB1” according to that precise syntactic relationship across the entire corpus, arranged in order of decreasing statistical significance.

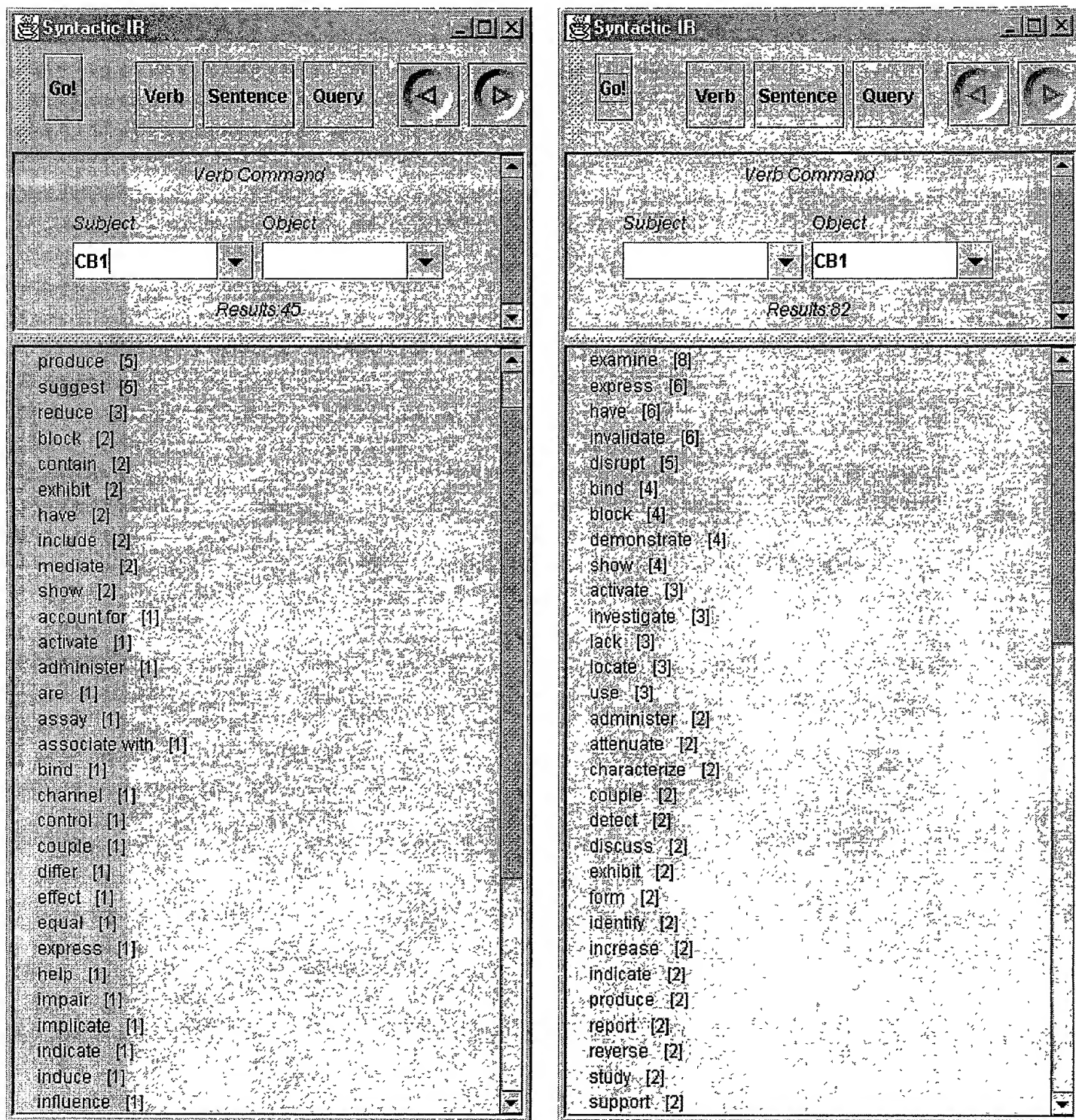


Figure 2

Figure 2 shows example syntactic profiling for keyword "CB1". Shown are possible subject or object roles that "CB1" fills in a corpus of 50,000 Medline abstracts used in the example implementation. These "action" roles are arranged in decreasing order of statistical significance.

The linguistic principle of "headness" implies that any phrase has a single head. This head is usually a noun in NPs and the main verb in the case of VPs. Although the head-modifier relation implies semantic dependence, the parser output defines a purely syntactic relationship at the single sentence level. However, the head may serve as an index for a list of phrases with occurrence frequencies across a collection. Syntactic profiling operators (like subject and object roles, and others involving prepositions and verb modifiers) are used to semantically cluster keywords based on their syntactic relationships. For instance, entities in a corpus can be associated with a "bag" of subject actions and a "bag" of object actions, as well as modifiers involving those actions. Each action in each one of these bags has a weight (the relative frequency of the noun-action pair within a document collection). Two keywords or entities are then said to be similar if their corresponding subject and object bags of actions are similar. This similarity can be quantitatively measured by the Euclidean distance between the relative frequency distributions associated with their bags of actions. Two nouns are very likely to be semantic or at least functional synonyms if their syntactic similarity is large. Hence, the enhanced search and indexing techniques solve the co-reference problem by studying the observed bag of actions statistics associated with the keywords in a corpus.

The following example illustrates this point. Consider the sentences "Several rats developed brain tumors. They spread to other organs." The possible antecedents of "They" are "brain tumors" and "rats".

action	BrainTumor	Rat	Organ	action	BrainTumor	Rat	Organ
affect	0.00	0.00	0.05	induce	0.04	0.05	0.00
appear	0.04	0.00	0.00	investigate	0.00	0.00	0.04
cause	0.00	0.00	0.04	involve	0.00	0.00	0.06
cause	0.00	0.02	0.00	model	0.00	0.08	0.00
characterize	0.00	0.00	0.04	observe	0.00	0.00	0.08
compare	0.04	0.03	0.00	occur	0.04	0.00	0.00
contain	0.04	0.06	0.00	originate	0.04	0.00	0.00
damage	0.04	0.00	0.00	overlook	0.04	0.00	0.00
decide	0.04	0.00	0.00	pose	0.04	0.00	0.00
decrease	0.00	0.03	0.05	prevent	0.00	0.00	0.04
define	0.04	0.00	0.00	produce	0.00	0.03	0.00
demonstrate	0.00	0.00	0.05	prolong	0.04	0.00	0.00
detect	0.00	0.00	0.05	provide	0.00	0.00	0.05
develop	0.04	0.03	0.00	receive	0.00	0.08	0.00
examine	0.00	0.00	0.05	release	0.04	0.00	0.00
exhibit	0.00	0.04	0.00	represent	0.00	0.00	0.04
express	0.00	0.06	0.04	result	0.00	0.05	0.00
factor	0.00	0.00	0.04	reveal	0.00	0.02	0.00
feed	0.00	0.05	0.00	show	0.12	0.14	0.06
form	0.00	0.00	0.04	suggest	0.00	0.03	0.00
give	0.00	0.03	0.00	target	0.00	0.00	0.06
implant	0.04	0.00	0.00	undergo	0.00	0.03	0.00
include	0.12	0.00	0.11	understand	0.04	0.00	0.00
increase	0.08	0.06	0.05	use	0.08	0.08	0.00

Table 2

In Table 2, relative frequencies for the top 20 actions associated to each of the terms "brain Tumor", "rat", and "organ" are shown. The first column corresponds to the union of all three terms' top 20 actions. Note: columns one and three do not add up to one due to numerical round off. Table 2 shows the union of the subject action bags (with the 20 most frequent actions) for "brain tumor" and "rat", as well as the object action bag (with the 20 most frequent actions) for "organ". The relative frequencies were computed for the top 20 actions for each of these terms in the 50,000 Medline abstracts. A zero entry in the table indicates that the action is not among the top 20 actions associated with the term heading the column. The corresponding similarities (Euclidean distances) between "brain tumor" and "organ", and "rat" and "organ" are 0.072 and 0.093, respectively. Hence "brain tumors" is the most likely antecedent of "They". Note that the relative weights  $1 - (0.072/(0.072+0.093))=0.56$ , and  $1 - (0.093/(0.072+0.093))=0.44$ , could be interpreted as corresponding probabilities of "brain tumor" and "rat" being the antecedent of "They" within the second sentence's context.

When a co-reference is not exact, a measure of uncertainty about the possible antecedents helps in any further processing of the sentences. Hence a weight or probability can be associated to triplets formed by "guessing" or "imputing" the antecedent of a co-reference. All triplets are placed in this framework by assigning a weight of 1.0 to all well-defined triplets. For the example, the associated weighted bag-of-sentences would be ([develop, several, verb-subject, 1], [develop, rat, verb-subject, 1], [develop, tumor, verb-object, 1], [develop, brain, verb-object, 1], [spread to, organ, verb-object, 1], [spread to, other, verb-object, 1], [spread to, tumor, verb-subject, 0.56], [spread to, rat, verb-subject, 0.44]). The process can be further refined by allowing a second pass over the text in order to update the weights (for example by replacing the weights with the average weights over all sentences co-referring the same object). The premise here is that a measure of uncertainty about possible antecedents is far better than a wrong antecedent.

Using the enhanced search and indexing techniques, the Syntactic Query Engine implements a scheme for phrase weighting and document similarity, which is similar to statistical weighting schemes employed for term-document matrices in information retrieval. The frequency of occurrence of the governing verb of a sentence or subject of a sentence across a document collection is normalized, in a fashion similar to IDF (inverse document frequency) weighting. With regard to within sentence and within documents normalization schemes, phrase frames may contain nested phrase frames at different depths. The main head carries the most semantic information, while head modifiers increase the amount of semantic information carried by the frame. However, the amount of information added to the head by a modifier is inversely proportional to its depth. This data is used to measure sentence statistics within and across documents, and to define document similarity based on sentence structure and content.

### 3 Implementation

#### 3.1 Syntactic Queries on Medline Abstracts

In an example implementation, a set of 50,000 Medline abstracts is indexed and searched. Admissible queries on the Medline abstracts database are of the same form as sentences in the abstracts. Syntactic queries can target useful subject-verb-object relationships in the database of parsed sentences that results from all indexing steps. Wild-cards are allowed to be substituted for certain parts of speech in the queries. The wild-card in the query must be a valid term in the lexicon preceded by a “#” symbol. Thus the wild-card represents any term in a sentence that shares the same part-of-speech, head-term and dependency relation with the term preceded by a #. Queries are parsed and represented in a similar fashion as sentences, except for the last two keys, namely document # and sentence #, which are dropped in the representation of queries.

Example implementations based on many different embodiments of the technology have been developed:

- Client/server architecture with Java GUI client and CORBA as the communication protocol
- Web server architecture with HTML GUI layout compatible with Netscape and Internet Explorer Web browser
- Dedicate ASP control interface (illustrated in Figure 3)

Other implementations are also contemplated. For example, embodiments of this technology are not restricted to a workstation or desktop implementation, and may be independent of a particular operating system. Also, for example, the interface concept is highly compatible, and ideal for deployment on portable devices, including cellular phones.

An example GUI interface provides five levels of control (Figure 4): two levels for querying and three levels for browsing information returned in response to a query. The levels of control for querying comprise: 1) query type selection; 2) query entry. The levels of control for browsing the results of a query comprise displays of: 1) word dependency maps ranked in decreasing order of statistical relevance; 2) summary list of complete sentences about a target entity, linked to the word dependency maps; 3) full text of the abstract, linked to each sentence in the list above.

The following example (*prepared by a non-biologist*) illustrates the query process:

#### QUERY

1. Choose from one of the following in a display menu: (a) find functional dependency relationships; (b) find object-subject relationships; (c) search syntactic collocations by example

2. The user chooses (a), and enters the name of an enzyme or gene, whose functions he/she wishes to have summarized. The query could be for instance: "Find all verb dependencies of PLCBeta1"

## BROWSING THE RESULTS OF A QUERY

1. The interface presents two statistically ranked lists of actions profiling:

PLCBeta1 as an object:

- 1) activate → PLCBeta1 (157 occurrences)
- 2) inhibit → PLCBeta1 (52 occurrences)
- 3) block → PLCBeta1 (7 occurrences)
- ...

PLCBeta1 as a subject:

- 1) PLCBeta1 → hybridize (89 occurrences)
- 2) PLCBeta1 → interrupts (12 occurrences)
- 3) PLCBeta1 → mediates (11 occurrences)
- 4) PLCBeta1 → regulates (10 occurrences)
- ...

2. Each entry in the ranked list above is linked to parent phrases in the corpus of 333,000 Medline abstracts. For instance, when the user selects the keyword "activate", he/she is presented with the list of 157 sentences that summarize what activates PLCBeta1:
  - 1) "Low concentration of tubulin activated PLCBeta1, whereas higher concentrations inhibited the enzyme."
  - 2) "Tubulin, Gq and phosphatidylinositol 4,5-bisphosphate interact to activate PLCBeta1"
  - 3) "A unique ability of tubulin to regulate PLCBeta1 was observed"
  - .....
3. Each of the sentences in the list above is linked to the original Medline abstract. The user can select a sentence of particular interest and read the full abstract.

Figures 5 through 7 illustrate an example Java embodiment of the GUI. Figures 8 through 10 illustrate an example HTML/Web browser implementation of the GUI. Finally, Figure 11 illustrates an example sentence similarity operator.

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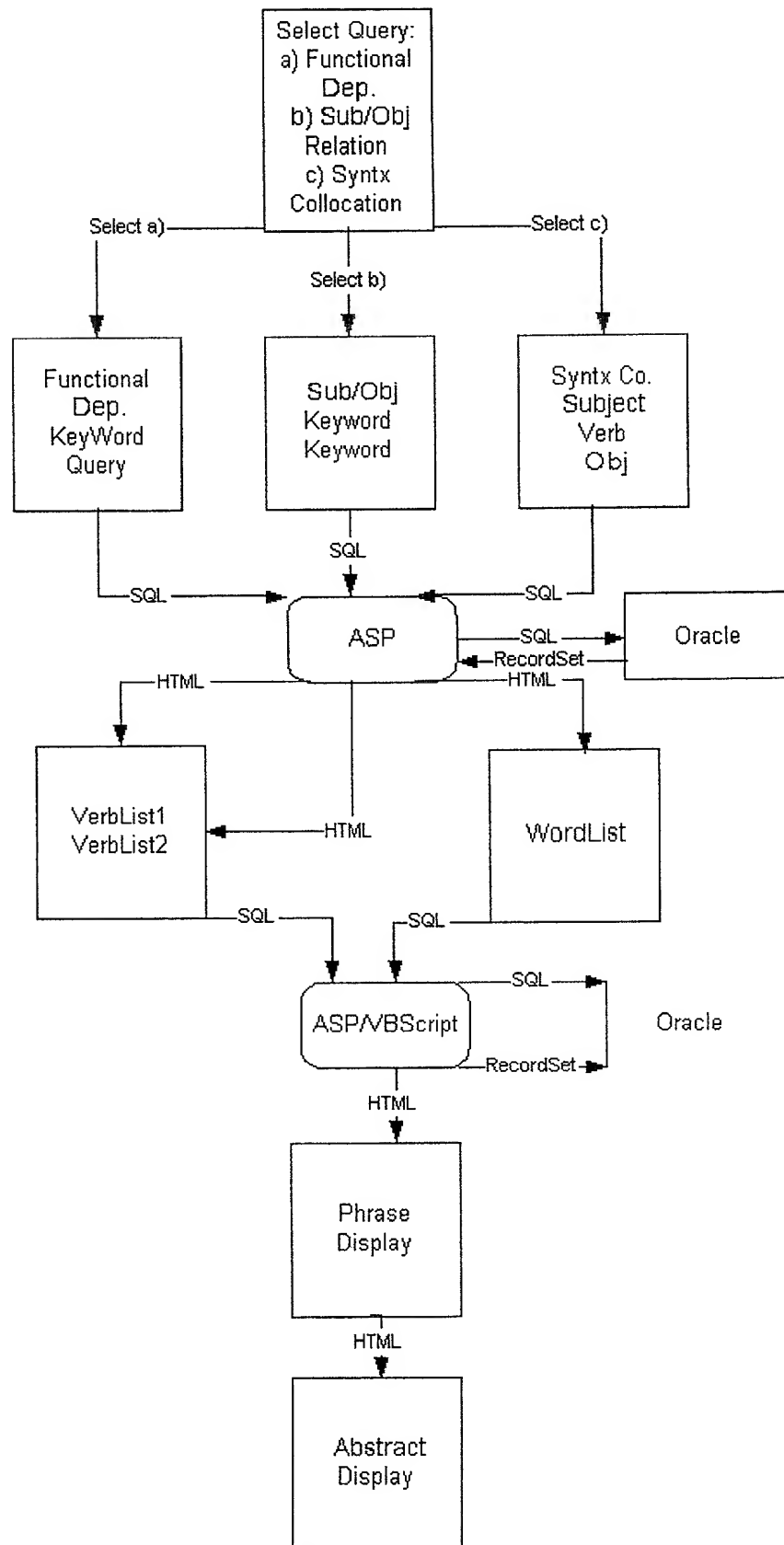


Figure 3: prototype GUI process flowchart



## LEVEL 1



**Figure 4:** the five levels of GUI control

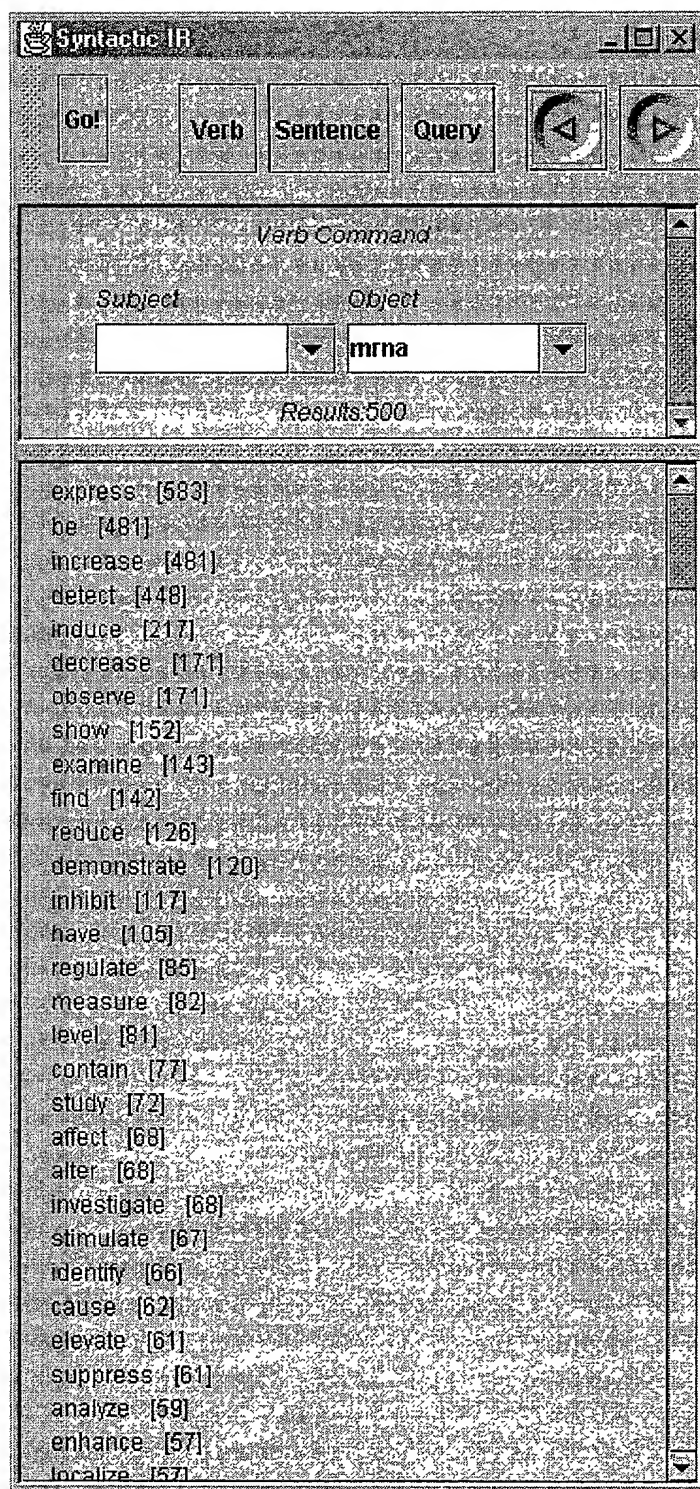


Figure 5

Figure 5 shows an example search tool based on syntactic parser output. A list of verbs or “actions” is shown for which mRNA (messenger RNA) is the object. The verbs are arranged in decreasing order of their statistical significance in a database of 50,000 Medline abstracts.

Syntactic IR

Go!

Verb Sentence Query

Sentence Command

Subject Verb Object Prep Modifier

Results: 58

[20176690 / 1 0]  
7. Thapsigargin (30 nM) and TPA (30 nM) increased the levels of HDC **mRNA** at 4 h, but PD98059 **suppressed** both the TPA-induced increases in the HDC **mRNA** level.

[20187609 / 1 0]  
Additionally, in 293 cells, which are constitutively overexpressing HSP-70 gene, the levels of HSP-70 **mRNA** were **suppressed** by C(2)-ceramide in parallel with the increase of apoptotic cells.

[20001958 / 1 0]  
Adenovirus mediated overexpression of IkappaBalpha, the inhibitor of NF-kappaB, completely **suppresses** MMP-1 and -3 protein and **mRNA** expression.

[20232462 / 1 0]  
After treatment with 20 nM E2 for 24 hours, PTP gamma **mRNA** was significantly **suppressed** in primary cultured cancerous and non-cancerous cells from breast cancer patients, as well as in the ER-positive MCF-7 cell line by 50%, 85%, and 66%, respectively.

[20046612 / 1 0]  
Antisense phosphorothioate oligodeoxynucleotides (S-ODN) to TBM **suppressed** baseline expression of TBM **mRNA** in both systems, but had no effect on glyceraldehyde phosphate dehydrogenase **mRNA** (GAPDH) expression.

[20079384 / 1 0]  
At 36 h post-HCG progesterone **suppressed** the LDL-R **mRNA** levels ( $P < 0.05$ ).

[20329935 / 1 0]  
Basal LOX-1 **mRNA** and protein were **suppressed** by antisense LOX-1.

[20409125 / 1 0]  
Both 13-cis retinoic acid and all-trans retinoic acid **suppressed** **mRNA** expression of cytochrome P450 1A2.

[20414687 / 1 0]  
Both constitutive and inducible ectopic Myc protein can **suppress** pdgfr-beta **mRNA** and protein.

[20184256 / 1 0]  
Cytokine analysis by competitive PCR revealed that IL-10 **mRNA** in the lymphoid organ was significantly **suppressed** in the PT(+) group, whereas levels of IFN-gamma, TNF-alpha and TGF-beta **mRNA** were insignificantly different after PT administration.

[20374481 / 1 0]  
Oligonucleotide diphosphate (DP-IV) **mRNA** expression in PWM-stimulated T cells is **suppressed** by specific DP-IV.

Figure 6

Figure 6 is a continuation of the example of Figure 4. Selecting the verb “suppress” retrieves all sentences that show what suppresses (=verb) mRNA (=object). Note that the search tool can resolve active, as well as passive verb forms.



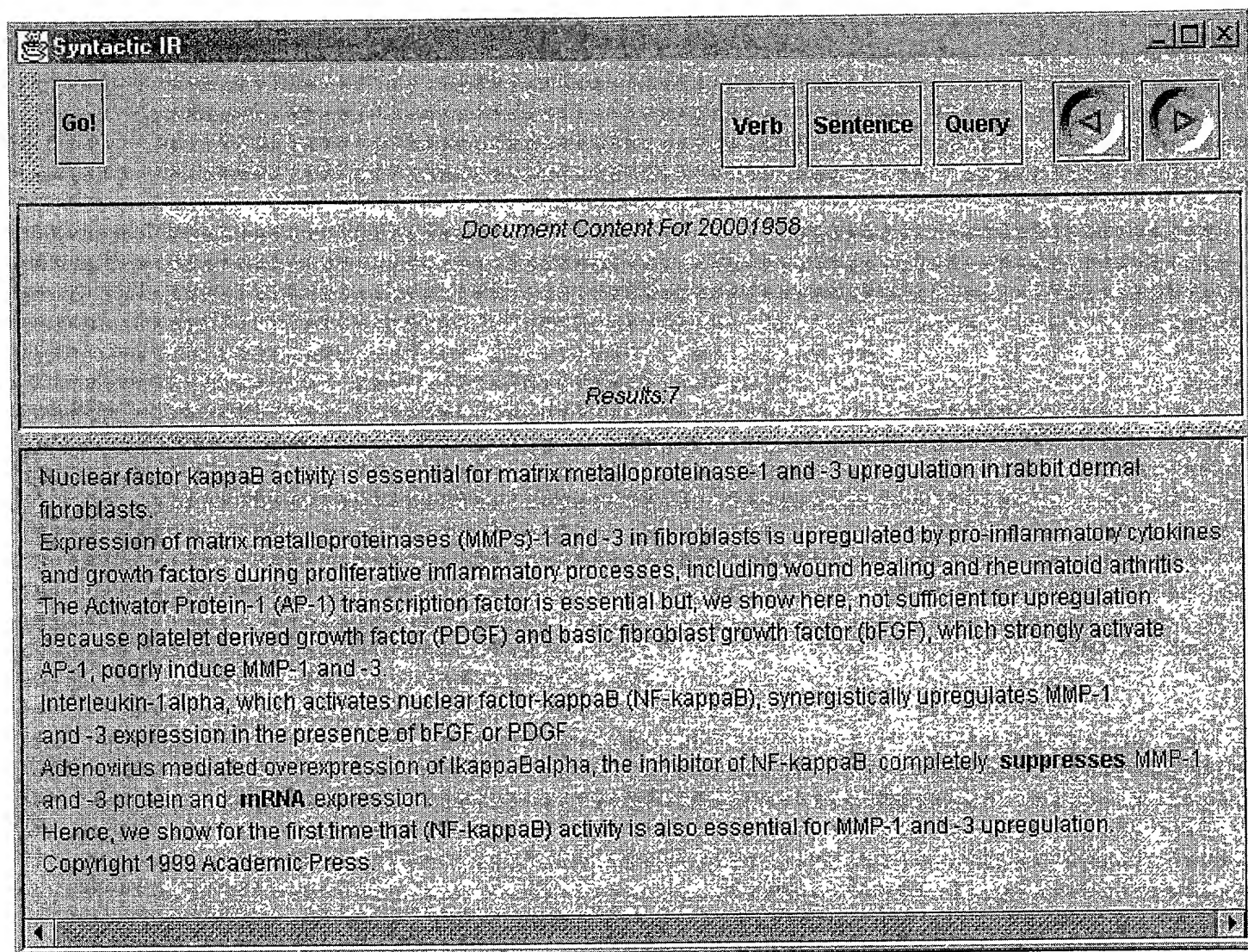


Figure 7

Figure 7 is a continuation of the example of Figure 5. Selecting a sentence returns the full text abstract.

## INSIGHTFUL CONFIDENTIAL

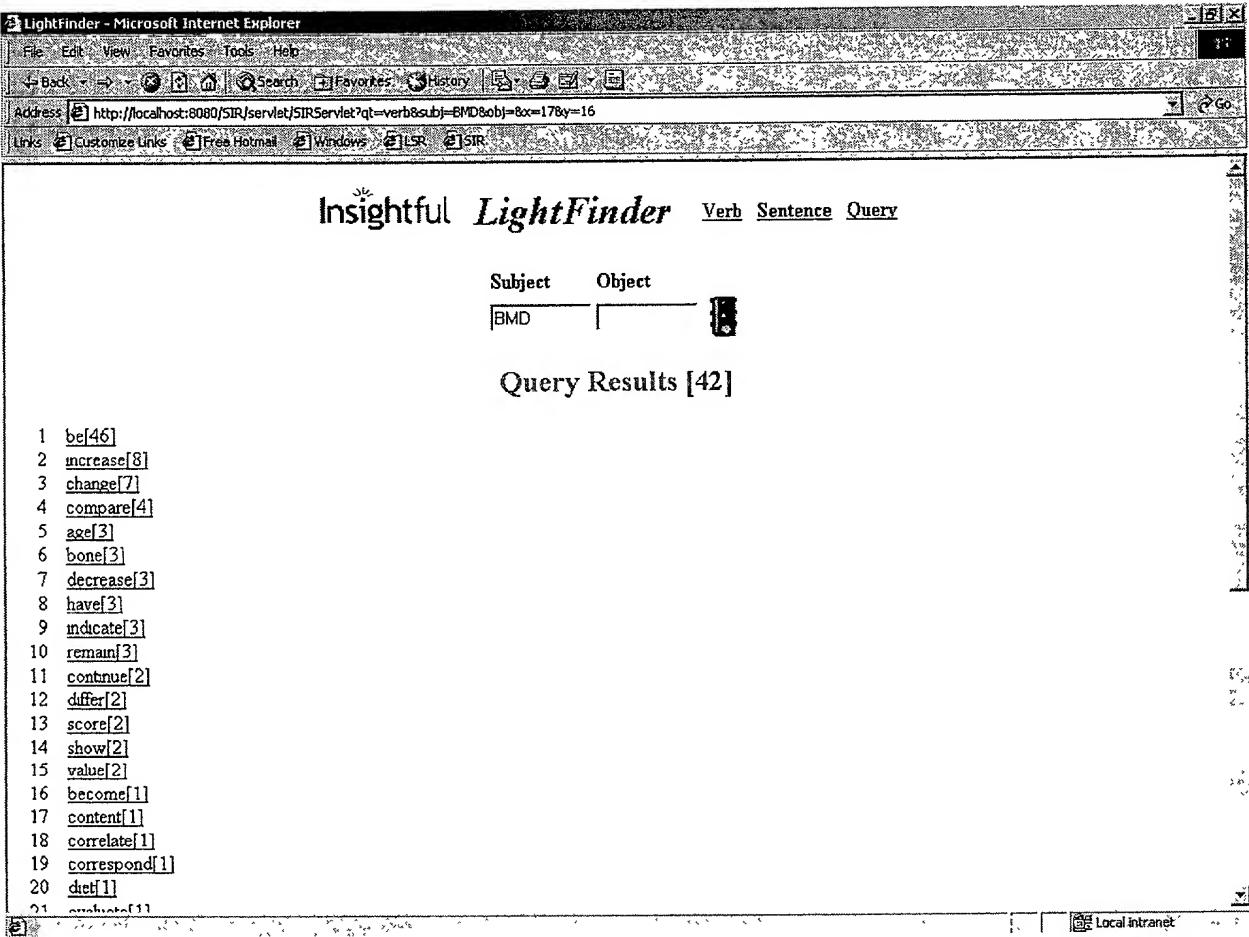


Figure 8

Figure 8 is an example web server embodiment. The web server search tool displays a list of verbs or “actions” for which BMD (Bone Mineral Density) is the subject. The verbs are arranged in decreasing order of their statistical significance in a database of 50,000 Medline abstracts.

LightFinder - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Search Favorites History

Address <http://localhost:8080/SIR/servlet/SIRServlet?qt=sent&verb=increase&subj=bmd&obj=> Go

Links [Customize Links](#) [Free Hotmail](#) [Windows](#) [LSR](#) [SIR](#)

---

Insightful *LightFinder* [Verb](#) [Sentence](#) [Query](#)

Subject	Verb	Object	Modifier	Preposition
bmd	increase			

Query Results [8]

- 1 BMD at the femoral neck, trochanter, and distal radius **increased** or was maintained with risedronate 5 mg treatment, but decreased in the placebo group [[doc](#)][[Similar](#)]
- 2 Bone mineral density (BMD) in proximal tibia **increased** similarly in a time-dependent manner in sham-operated NA and SD rats [[doc](#)][[Similar](#)]
- 3 In 4 years femoral neck BMD **increased** by 3.0% in the calcitriol group, but decreased by 1.6% in the control group (P = 0.009) [[doc](#)][[Similar](#)]
- 4 In the overall population, the mean (SE) lumbar spine BMD **increased** 1.9 from baseline in the risedronate 5 mg group (P < 0.001) and decreased 1.0 in the placebo group (P = 0.005) [[doc](#)][[Similar](#)]
- 5 Lumbar spine bone mineral density (BMD) by dual-energy X-ray absorptiometry (DXA) **increased** by 0.6%, 3.6% and 8.1% after 48 weeks in groups L, M and H respectively, responses in groups M and H being significantly higher than in L (p<0.05, Mann-Whitney U-test) [[doc](#)][[Similar](#)]
- 6 Postpartum, BMD **increased** in the arms (2.8%, P < 0.01) and legs (1.9%, P < 0.01) but decreased in the pelvis (-3.2%, P < 0.05) and spine (-4.6%, P < 0.01) compared with prepregnancy values [[doc](#)][[Similar](#)]
- 7 The lumbar spine BMD **increased** significantly faster in the BB and Bb groups (7.3% and 7.0%, respectively) compared with the bb group (2.5%) during 1 year of cyclic etidronate therapy (400 mg/day) and calcium supplementation (1000 mg/day) [[doc](#)][[Similar](#)]
- 8 Total body and lumbar spine BMD **increased** from baseline in both groups, with a greater **increase** in the CEE group (P < 0.05) [[doc](#)][[Similar](#)]

Done Local intranet

Figure 9

Figure 9 is a continuation of the example of Figure 7. Selecting the verb “increase” retrieves all sentences that show all circumstances where BMD (=subject) increases (=verb) mRNA.

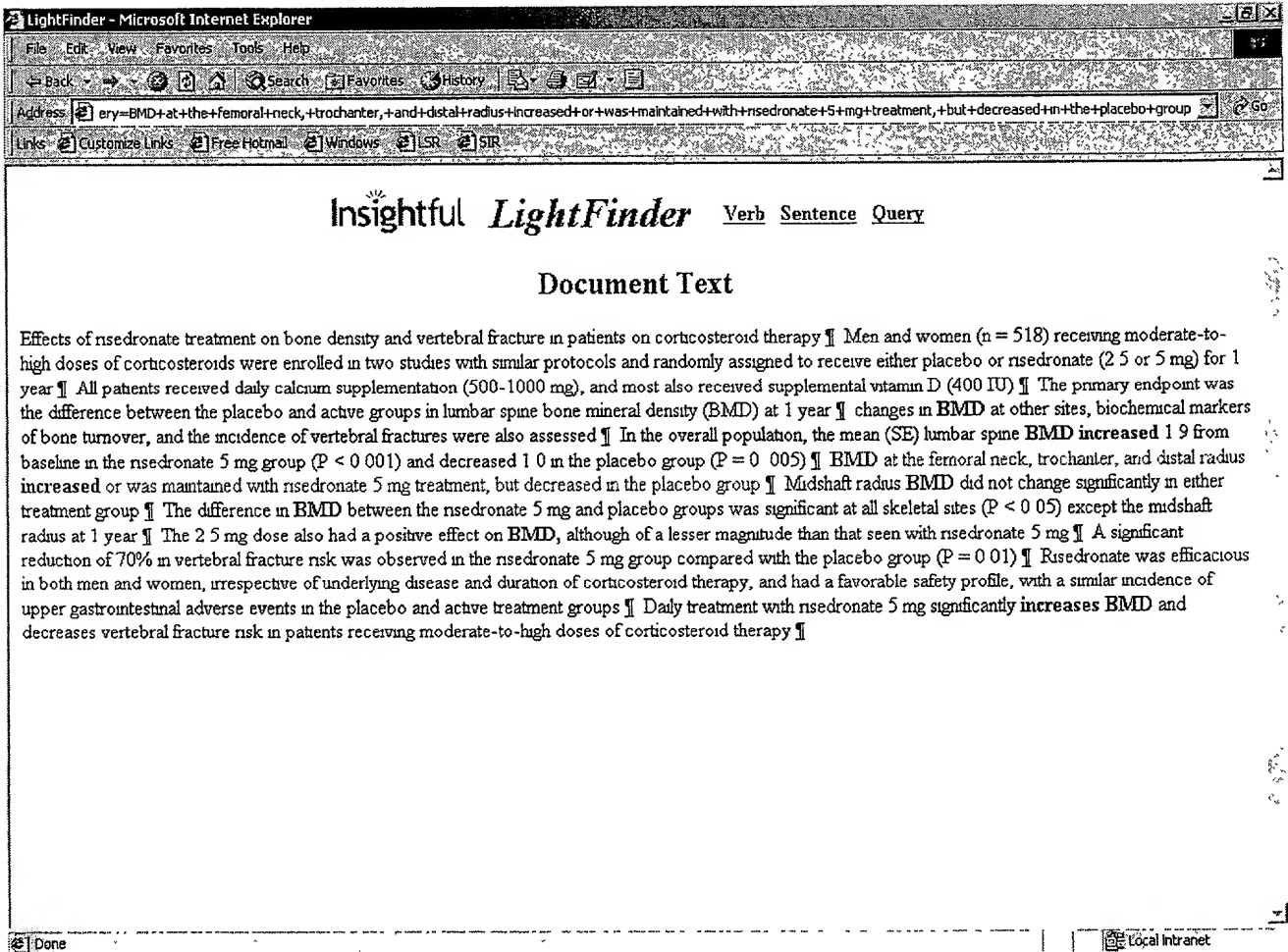


Figure 10

Figure 10 is a continuation of the example of Figure 8. Selecting any sentence returns the full text abstract showing the sentence in context.

# INSIGHTFUL CONFIDENTIAL

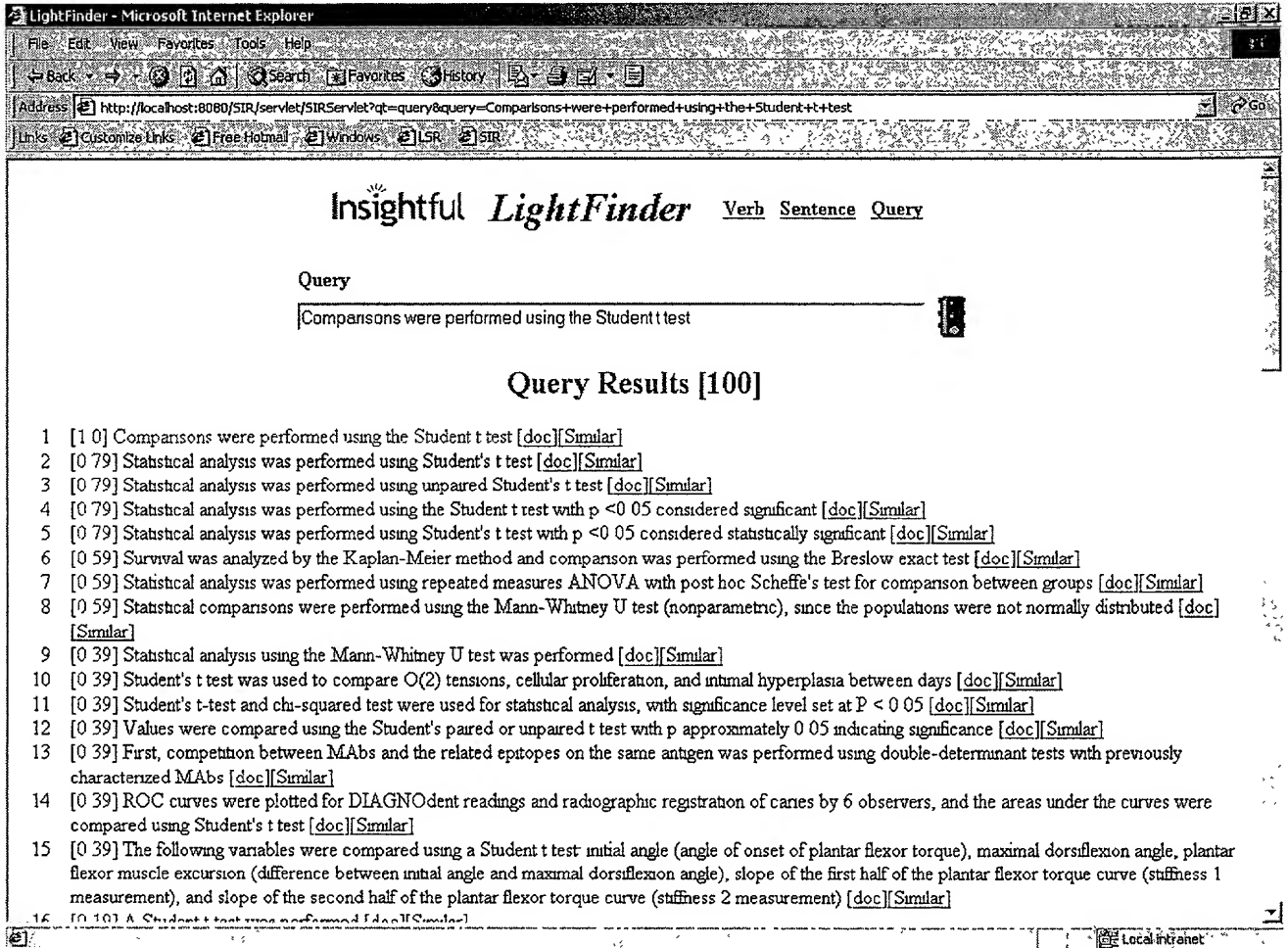


Figure 11

Figure 11 is an example illustration of the sentence similarity operator. The search tool receives the sentence "Comparisons were performed using the Student t test", and determines a list of similar sentences in the corpus.



## APPENDIX B

Variable	Mean	SD	Min	Max
Age	34.5	10.5	18	65
Gender	Male	10.5	0	1
Marital status	Married	10.5	0	1
Education	High school	10.5	0	1
Occupation	Manager	10.5	0	1
Income	High	10.5	0	1
Health	Good	10.5	0	1
Stress	Low	10.5	0	1
Life satisfaction	High	10.5	0	1
Work satisfaction	High	10.5	0	1
Job satisfaction	High	10.5	0	1
Organizational commitment	High	10.5	0	1
Employee engagement	High	10.5	0	1
Turnover intention	Low	10.5	0	1
Job performance	High	10.5	0	1
Customer satisfaction	High	10.5	0	1
Service quality	High	10.5	0	1
Brand loyalty	High	10.5	0	1
Repurchase intention	High	10.5	0	1
Word of mouth	High	10.5	0	1
Net promoter score	High	10.5	0	1
Customer retention	High	10.5	0	1
Customer lifetime value	High	10.5	0	1
Customer equity	High	10.5	0	1
Market share	High	10.5	0	1
Competitive advantage	High	10.5	0	1
Brand awareness	High	10.5	0	1
Brand image	High	10.5	0	1
Brand reputation	High	10.5	0	1
Brand personality	High	10.5	0	1
Brand identity	High	10.5	0	1
Brand positioning	High	10.5	0	1
Brand strategy	High	10.5	0	1
Brand management	High	10.5	0	1
Brand communication	High	10.5	0	1
Brand promotion	High	10.5	0	1
Brand advertising	High	10.5	0	1
Brand marketing	High	10.5	0	1
Brand sales	High	10.5	0	1
Brand revenue	High	10.5	0	1
Brand profit	High	10.5	0	1
Brand value	High	10.5	0	1
Brand equity	High	10.5	0	1
Brand strength	High	10.5	0	1
Brand resilience	High	10.5	0	1
Brand flexibility	High	10.5	0	1
Brand innovation	High	10.5	0	1
Brand differentiation	High	10.5	0	1
Brand uniqueness	High	10.5	0	1
Brand consistency	High	10.5	0	1
Brand coherence	High	10.5	0	1
Brand clarity	High	10.5	0	1
Brand simplicity	High	10.5	0	1
Brand memorability	High	10.5	0	1
Brand recognizability	High	10.5	0	1
Brand recall	High	10.5	0	1
Brand association	High	10.5	0	1
Brand meaning	High	10.5	0	1
Brand symbolism	High	10.5	0	1
Brand metaphor	High	10.5	0	1
Brand analogy	High	10.5	0	1
Brand simile	High	10.5	0	1
Brand personification	High	10.5	0	1
Brand anthropomorphism	High	10.5	0	1
Brand socialization	High	10.5	0	1
Brand social identity	High	10.5	0	1
Brand social capital	High	10.5	0	1
Brand social network	High	10.5	0	1
Brand social structure	High	10.5	0	1
Brand social interaction	High	10.5	0	1
Brand social influence	High	10.5	0	1
Brand social power	High	10.5	0	1
Brand social status	High	10.5	0	1
Brand social reputation	High	10.5	0	1
Brand social image	High	10.5	0	1
Brand social personality	High	10.5	0	1
Brand social identity	High	10.5	0	1
Brand social capital	High	10.5	0	1
Brand social network	High	10.5	0	1
Brand social structure	High	10.5	0	1
Brand social interaction	High	10.5	0	1
Brand social influence	High	10.5	0	1
Brand social power	High	10.5	0	1
Brand social status	High	10.5	0	1
Brand social reputation	High	10.5	0	1
Brand social image	High	10.5	0	1
Brand social personality	High	10.5	0	1

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Political background

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United Arab Emirates.

Country Profile Uae 1997 / 1998.

Political background.

International relations &amp; defence.

The UAE is a small country surrounded by powerful neighbours in an unstable part of the world

Its international relations over the past 20 years have reflected this and it has followed a course of delicate diplomacy.

Although it has been part of the six-member pro-Western Gulf Co-operation Council (GCC) since the latter was founded in 1981, the UAE has tended to take a more accommodating stance than its co-members, especially Saudi Arabia and Kuwait, towards perceived external threats such as Iran.

This reflects the fact that both Dubai and Sharjah have substantial Iranian populations, and that Iran is an important economic partner for the UAE.

Relations with Iran.

With the outbreak of the Iran-Iraq war in 1980, the UAE found itself walking a diplomatic tightrope.

It was one of the first Arab countries to receive Iranian officials after the 1979 Islamic revolution and continued to welcome them even after the war with Iraq had started.

However, it also contributed to Iraq's war effort when it became clear that Iraq might lose the struggle if it did not receive backing.

After the Gulf war of 1991 the UAE made great efforts to forge closer ties with Iran but in 1992 Iran took control of the whole of the Gulf island of Abu Musa which it had shared with Sharjah since 1971.

The action made the UAE nervous and since then this unease has translated into overt opposition to perceived Iranian expansionism.

Since 1995 alarm has grown as Iran has strengthened its grip on the islands of Abu Musa, Greater Tunb and Lesser Tunb.

The UAE has frequently called for the dispute to be resolved either through bilateral negotiations or by the International Court of Justice in The Hague.

Its position has been supported by the GCC and the Arab League, both of which have argued that a normalisation in ties with Iran is dependent on the affair being resolved.

Relations with Iran have caused internal friction within the federation.

Given its strong trade links and large indigenous Iranian population, Dubai has maintained a conciliatory stance towards Tehran, arguing that close contacts will ultimately lead to a solution of the dispute.

In contrast, Sharjah and Ras al-Khaimah, whose territorial waters adjoin the three islands, have called for greater steps to be taken in forcing the Iranian regime either to hand back the islands or, at the very least, to allow a joint administration to be set up.

Relations with Iraq.

Despite supporting Iraq in the Iran-Iraq war, the UAE has also had much to fear from the ambitions of the Iraqi leader, Saddam Hussein.

In 1988 Baghdad accused the UAE, along with Kuwait, of breaking OPEC oil quotas, driving prices down and depriving Iraq of revenue to rebuild its economy after the war with Iran.

The fact that this was one reason given by Iraq for its invasion of Kuwait in 1990 was not lost on the UAE.

Nevertheless, Sheikh Zayed has taken a lead in calling on the UN to relax sanctions against Iraq in order to ease the suffering of its people.

More important to Sheikh Zayed, however, is the desire to build up Iraq to balance Iranian power.

Dubai, too, is interested in having sanctions on Iraq lifted to take advantage of the trade that would then ensue.

Oil wealth.

Over the past few years the country's oil wealth has been a mixed blessing.

The UAE was criticised for allegedly not bearing enough of the burden in the Gulf war effort against Iraq, particularly as economically, it emerged as one of the few regional beneficiaries. Although it mobilised its troops and paid around \$10bn towards the cost of the war, it gained more from the crisis than it lost.

It benefited, for instance, from higher oil revenue as prices rose and it increased production to make up for lost Iraqi and Kuwaiti output.

Dubai gained from the relocation of business from Kuwait.

During the 1990s the UAE has taken a back seat in OPEC, generally supporting the line adopted by Saudi Arabia.

Dubai's refusal to make pro-rata cuts in line with the federation's oil production quota has placed the burden of compliance solely on Abu Dhabi.

This has caused some difficulties for Abu Dhabi, given that its foreign oil partners have ploughed significant sums into raising the emirate's sustainable oil capacity, much of which has remained idle.

Indeed, Abu Dhabi is reckoned to have over 500,000 barrels/day (b/d) of spare capacity in place.

However, a 25% drop in Dubai's oil production over the period 1993-97 has provided some relief for Abu Dhabi allowing it to raise output over the period by about 150,000 b/d to an estimated 1.9m b/d.

New OPEC quotas, which came into force on January 1st 1998, have also proved a blessing for the oil-rich emirate, as the 205,000 b/d increase in the UAE quota (taking it to 2.366m b/d) has been covered solely by Abu Dhabi.

Total Abu Dhabi production now stands at over 2.1m b/d.

Defence pacts.

Since the end of the Gulf war, the UAE and the rest of the GCC have been reluctant to rely for their security on the so-called Damascus Declaration group of countries: the GCC, Egypt and Syria.

The latter two sent troops to the Gulf to help to oust Iraq from Kuwait, after which they agreed to station troops permanently in the region.

However, GCC states, even though they suffer from a lack of manpower, have been reluctant to put the arrangement into practice.

Even internally, the GCC has been unable to agree on a joint force.

Oman, for instance, has persistently advocated the expansion of the current joint force from a few thousand to 100,000 troops, but the UAE has opposed this because it fears domination by Saudi Arabia.

Instead, the UAE has looked to the West, in particular to the US, to guarantee its defence.

In 1991 a loose defence pact was signed, giving the US rights to base troops and equipment in the UAE.

Since then the UAE (in fact mainly Abu Dhabi) has spent billions of dollars on buying sophisticated military equipment, but it lacks the personnel and skills to make full use of them.

The purchases were essentially designed to draw the US and other Western powers such as France into close arrangements with the UAE.

This table shows the Defence forces, 1996.

Armed forces is \_NUM.

Army is \_NUM.

Navy is \_NUM.

Air Force is \_NUM.

Source: International Institute for Strategic Studies, The Military.

Compared with other Arab countries, the UAE's armed forces as a percentage of the national population are large.

This is because federal arrangements coexist with individual emirate defence provisions.

Although the different emirates nominally unified their forces in 1976, there is still little federal identity.

Since the end of the Gulf war, the number of foreign nationals in the military has fallen to around 30% of the total.

Defence is a major item of government expenditure.

In 1996 the federal ministries of defence, justice and the interior together spent just over 40% of the total budget.

Abu Dhabi and, to a lesser extent, Dubai make separate defence purchases, with the costs considered a contribution to the federal budget (see Reference table 1).

A significant increase in UAE defence spending has been expected since 1995, when the UAE announced its intention to spend \$10bn-12bn on new weaponry.

The procurement programme was held up as a sign of the federation's desire to bolster its defensive capabilities in the face of the perceived Iranian threat and to play a more active role in safeguarding shipping through the strategic straits of Hormuz.

This table shows the Military indicators.

(1996 unless otherwise indicated).

Total active armed forces is \_NUM.

Military expenditure (\$ m) is \_NUM.

Military expenditure (% of GDP) is \_NUM.

Military expenditure per head (\$) is \_NUM.

Arms imports (\$ m; 1994) is \_NUM.

Arms imports (% total imports; 1994) is \_NUM.

Cumulative arms transfers deliveries (\$ m; 1992-94) is \_NUM.

Armed forces per '000 people (soldiers) is \_NUM.

Sources: International Institute for Strategic Studies, The Military.

Balance 1996/97; US Arms Control and Disarmament Agency, World Military.

Despite years of discussions with prospective suppliers, only one major deal has been signed, a \$3.4bn contract with the French fighter aircraft firm, Dassault, for 30 new Mirage 2000-09 generation fighters, some in replacement of 22 existing Mirages.

This should leave UAE officials more time to evaluate offers for a further order for 50 aircraft worth some \$4.6bn.

Lockheed Martin, a US manufacturer of F-16 aircraft, is the likeliest winner, with the UK's British Aerospace (BAe) and the Eurofighter 2000 next in line.

No award has yet been made for a \$1bn order to supply the navy with up to eight ocean-capable patrol boats (OCPBs) and a \$1bn-2bn order for six small frigates.

Pressure to award the second contract has eased after the purchase in 1996 of two second-hand frigates from the Netherlands.

These are due to be delivered in the first half of 1998.

The delays in awarding the contracts have been attributed to Abu Dhabi re-evaluating the

programme and assessing means of alternative financing, including the possibility of payment in oil.

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Economy

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United Arab Emirates.

Country Profile Uae 1997 / 1998.

Economy.

Economic structure.

This table shows the Main economic indicators, 1996.

Real GDP growth(a) (%) is \_NUM.

Consumer price inflation (%) is \_NUM.

Current account (\$ m) is \_NUM.

External debt(a) (\$ bn) is \_NUM.

Exchange rate (Dh:\$) is \_NUM.

Population(b) (m) is \_NUM.

(a) EIU estimate.

(b) Official preliminary estimate.

The mainstay of the UAE economy is oil and gas (see Reference tables 10 and 11).

By far the largest oil producer is Abu Dhabi, but some contribution comes from Dubai and, to a much lesser extent, Sharjah and Ras al-Khaimah (see Reference table 13).

Despite oil's importance, its contribution to GDP has been declining in recent years from about 60% in 1980 to just 35% in 1996.

Nevertheless, the significance of this decline should not be overstated.

Much of the non-oil economy depends on the public sector and public-sector contracts, and the amount of public spending is directly related to oil revenue.

Government consumption is a major element in demand in the economy, equivalent to over 16 % of GDP (see Reference tables 8 and 9).

Weak oil prices during the period 1993-95 were reflected in a low average level of GDP growth (see Reference table 7).

This table shows the Gross domestic product by emirate.

(current prices).

1995 is \_NUM.

Dh m is \_TABLE % share Dh m % share.

Abu Dhabi is \_NUM.

Dubai is \_NUM.

Sharjah is \_NUM.

Ras al-Khaimah is \_NUM.

Ajman is \_NUM.

Fujairah is \_NUM.

Umm al-Qaiwain is \_NUM.

Total is \_NUM.

Sources: Federal Ministry of Planning, Annual Economic Report 1996; UAE.

Dubai is the centre for regional trade.

Its importance to the region in this respect has been growing, especially since the Gulf war, and now extends as far as the southern republics of the former Soviet Union.

Re- exports are the mainstay of the trading system, with Dubai's foreign trade more than twice the value of its own national GDP.

This table shows the Re-exports by emirate.

(\$ m).

1995 is \_NUM.

Dubai is \_NUM.

Sharjah is \_NUM.

Abu Dhabi is \_NUM.

Other (mainly non-recorded) is \_NUM.

Total is \_NUM.

The value of UAE re-exports in 1996 was around \$10.1bn (30% of total exports).

A significant proportion-about 40%-is unrecorded.

This comprises goods leaving Dubai by dhow (a vessel characteristic of the Gulf) and merchandise passing through the Jebel Ali Free Zone, also in Dubai.

In total, Dubai accounts for around 85% of re-exports.

This table shows the UAE merchandise exports.

(\$ m).

1995 is \_NUM.

Total is \_NUM.

Crude oil is \_NUM.

Gas is \_NUM.

Total oil & gas is \_NUM.

Re-exports is \_NUM.

Other non-oil exports is \_NUM.

Total non-oil exports is \_NUM.

The UAE economy is rather larger than Kuwait's, but less than one-third the size of Saudi Arabia's.

Its GDP per head is broadly similar to Kuwait's, but it is well behind that of leading industrial countries.

This table shows the Comparative economic indicators, 1996.

UAE is \_TABLE Saudi Arabia Kuwait Japan.

GDP (\$ bn) is \_NUM.

GDP per head (\$) is \_NUM.

Oil production ('000 b/d) is \_NUM.

Exports of goods (\$ bn) is \_NUM.

Imports of goods (\$ bn) is \_NUM.

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[illegible]

752  
Afghan Afghanistan  
Afghani Afghanistan  
Albanian Albania  
Algerian Algeria  
American US  
Andorran Andorra  
Angolan Angola  
Anguillian Anguilla  
Antiguan Antigua  
Antilles Netherland-Antilles  
Argentine Argentina  
Argentinian Argentina  
Aruban Aruba  
Australian Australia  
Austrian Austria  
Azerbaijani Azerbaijan  
Bahamian Bahamas  
Bahraini Bahrain  
Bangladeshi Bangladesh  
Barbadian Barbados  
Basothian Basotho  
Batswanian Batswana  
Belarusian Belarus  
Belgian Belgium  
Belizean Belize  
Beninese Benin  
Bermudan Bermuda  
Bhutanese Bhutan  
Bolivian Bolivia  
Bosnia Bosnia-and-Herzegovina  
Bosnian Bosnia-and-Herzegovina  
Botswanian Botswana  
Brazilian Brazil  
Brazzaville-Congolese Congo-(Brazzaville)  
British United-Kingdom  
Bruneian Brunei  
Bulgarian Bulgaria  
Burkina Burkina-Faso  
Burkinabe Burkina-Faso  
Burma Myanmar-(Burma)  
Burmese Myanmar-(Burma)  
Burundian Burundi  
Cambodian Cambodia  
Cameroonien Cameroon  
Canadian Canada  
Cape-Verdian Cape-Verde  
Cayman Cayman-Islands  
Central-African Central-African-Republic  
Chadian Chad  
Chilean Chile  
Chinese China  
Colombian Colombia  
Comoran Comoros  
Congo Congo-(Democratic-Republic)  
Congolese Congo-(Democratic-Republic)  
Costa-Rican Costa-Rica  
Cote-D'Ivoire Cote-d'Ivoire  
Croatian Croatia  
Cuban Cuba

## Governments

Cypriot	Cyprus	
Czech	Czech-Republic	
Czechoslovak	Czech-Republic	
Czechoslovakian	Czech-Republic	
Dane	Denmark	
Danish	Denmark	
Democratic-Republic-of-the-Congo		Congo- (Democratic-Republic)
Djiboutian	Djibouti	
Dominican	Dominican-Republic	
Dutch	Netherlands	
Ecuadorian	Ecuador	
Egyptian	Egypt	
English	United-Kingdom	
Englishman	United-Kingdom	
Englishmen	United-Kingdom	
Englishwoman	United-Kingdom	
Englishwomen	United-Kingdom	
Equatoguinean	Equatorial-Guinea	
Eritrean	Eritrea	
Estonian	Estonia	
Ethiopian	Ethiopia	
Fijian	Fiji	
Finnish	Finland	
French	France	
Gabonese	Gabon	
Gambian	The-Gambia	
German	Germany	
Ghanaian	Ghana	
Greek	Greece	
Greenlandic	Greenland	
Grenadian	Grenada	
Guaman	Guam	
Guatemalan	Guatemala	
Guianese	Guiana	
Guinea-Bissauan	Guinea-Bissau	
Guinean	Guinea	
Guyanese	Guyana	
Haitian	Haiti	
Helenian	Greece	
Hercegovina	Bosnia-and-Hercegovina	
Honduran	Honduras	
Hong-Kongnese	Hong-Kong	
Hungarian	Hungary	
Icelander	Iceland	
Icelandic	Iceland	
Indian	India	
Indonesian	Indonesia	
Iranian	Iran	
Iraqi	Iraq	
Irish	Ireland	
Irishman	Ireland	
Irishwoman	Ireland	
Israeli	Israel	
Italian	Italy	
Ivorian	Ivory-Coast	
Jamaican	Jamaica	
Japanese	Japan	
Jordanian	Jordan	
Kazak	Kazakhstan	
Kazakh	Kazakhstan	

Kazakstan	Kazakhstan
Kenyan	Kenya
Korean	South-Korea
Kosovo	Bosnia-and-Hercegovina
Kuwaiti	Kuwait
Kyrgyz	Kyrgyzstan
Laotian	Laos
Latvian	Latvia
Lebanese	Lebanon
Lesothian	Lesotho
Liberian	Liberia
Libyan	Libya
Liechtensteiner	Liechtenstein
Lithuanian	Lithuania
Luxembourger	Luxembourg
Lybia	Libya
Lybian	Libya
Macauan	Macau
Macedonian	Macedonia
Madagascan	Madagascar
Mahoran	Mahora
Malawian	Malawi
Malaysian	Malaysia
Maldivian	Maldives
Malian	Mali
Maltese	Malta
Marshallese	Marshall-Islands
Martiniquais	Martinique
Mauritanian	Mauritania
Mauritian	Mauritius
Mexican	Mexico
Moldavia	Moldova
Moldavian	Moldova
Moldovan	Moldova
Monacan	Monaco
Mongolian	Mongolia
Montenegro	Yugoslavia
Montserratian	Montserrat
Moroccan	Morocco
Motswanian	Motswana
Mozambican	Mozambique
Namibian	Namibia
Nepalese	Nepal
New-Caledonian	New-Caledonia
New-Zealander	New-Zealand
Nicaraguan	Nicaragua
Nigerian	Nigeria
Nigerien	Niger
North-Korean	North-Korea
Norwegian	Norway
Omani	Oman
Pacific-Islander	Pacific-Islands
Pakistani	Pakistan
Palestine	The-Occupied-Territories
Palestinian	The-Occupied-Territories
Panamanian	Panama
Papua-New-Guinean	Papua-New-Guinea
Papuan	Papua-New-Guinea
Paraguayan	Paraguay
Peruvian	Peru

# Country-term-4

Philippine	Philippines
Philippino	Philippines
Polish	Poland
Portuguese	Portugal
Puerto-Rican	Puerto-Rico
Qatari	Qatar
Romanian	Romania
Russian	Russia
Russian-Federation	Russia
Rwandan	Rwanda
Saint-Lucian	Saint-Lucia
Salvadoran	El-Salvador
Samoan	Samoa
Sanmarinese	San-Marino
Sao-Tomean	Sao-Tome-and-Principe
Saudi	Saudi-Arabia
Saudi-Arabian	Saudi-Arabia
Scotland	United-Kingdom
Scottish	United-Kingdom
Senegalese	Senegal
Serbia	Yugoslavia
Serbia-Montenegro	Yugoslavia
Serbian	Yugoslavia
Seychellois	Seychelles
Sierra-Leonean	Sierra-Leone
Singaporean	Singapore
Slovak	Slovakia
Slovakian	Slovakia
Slovenian	Slovenia
Solomon-Islander	Solomon-Islands
Somali	Somalia
South-African	South-Africa
South-Korean	South-Korea
Soviet	Russia
Soviet-Union	Russia
Spaniard	Spain
Spanish	Spain
Sri-Lankan	Sri-Lanka
Sudanese	Sudan
Surinam	Suriname
Surinamese	Suriname
Swazi	Swaziland
Swede	Sweden
Swedish	Sweden
Swiss	Switzerland
Syrian	Syria
Taiwanese	Taiwan
Tajik	Tajikistan
Tajiki	Tajikistan
Tanzanian	Tanzania
Thai	Thailand
Timorese	East-Timor
Togolese	Togo
Tongan	Tonga
Trinidad	Trinidad-and-Tobago
Trinidadian	Trinidad-and-Tobago
Tunisian	Tunisia
Turk	Turkey
Turk-Islander	Turks-and-Caicos-Islands
Turkish	Turkey



# Governing term - 5

Turkmen	Turkmenistan
U.K.	United-Kingdom
U.S.	US
U.S.A.	US
U.S.S.R.	Russia
UK	United-Kingdom
US	US
USA	US
USSR	Russia
USSR	Russia
Ugandan	Uganda
Ukrainian	Ukraine
Ukranian	Ukraine
United-States	US
United-States-of-America	US
Uruguayan	Uruguay
Uzbek	Uzbekistan
Vanuatuan	Vanuatu
Venezuelan	Venezuela
Vietnamese	Vietnam
Virgin-Islander	British-Virgin-Islands
West-Samoan	Western-Samoa
Yemeni	Yemen
Yugoslav	Yugoslavia
Yugoslavian	Yugoslavia
Zairean	Zaire
Zambian	Zambia
Zimbabwean	Zimbabwe
afghan	Afghanistan
afghani	Afghanistan
afghanistan	Afghanistan
albania	Albania
albanian	Albania
algeria	Algeria
algerian	Algeria
american	US
andorra	Andorra
andorran	Andorra
angola	Angola
angolan	Angola
anguillan	Anguilla
anguille	Anguilla
antigua	Antigua
antiguan	Antigua
antilles	Netherland-Antilles
argentina	Argentina
argentine	Argentina
argentinian	Argentina
aruba	Aruba
aruban	Aruba
australia	Australia
australian	Australia
austria	Austria
austrian	Austria
azerbaijan	Azerbaijan
azerbaijani	Azerbaijan
bahamas	Bahamas
bahamian	Bahamas
bahrain	Bahrain
bahraini	Bahrain

bangladesh	Bangladesh
bangladeshi	Bangladesh
barbadian	Barbados
barbados	Barbados
basothian	Basotho
basotho	Basotho
batswana	Batswana
batswanian	Batswana
belarus	Belarus
belarusian	Belarus
belgian	Belgium
belgium	Belgium
belize	Belize
belizean	Belize
benin	Benin
beninese	Benin
bermuda	Bermuda
bermudan	Bermuda
bhutan	Bhutan
bhutanese	Bhutan
bolivia	Bolivia
bolivian	Bolivia
bosnia	Bosnia-and-Hercegovina
bosnia-and-hercegovina	Bosnia-and-Hercegovina
bosnia-and-hercegovina	Bosnia-and-Hercegovina
bosnia-and-hercegovina	Bosnia-and-Hercegovina
bosnian	Bosnia-and-Hercegovina
botswana	Botswana
botswanian	Botswana
brazil	Brazil
brazilian	Brazil
brazzaville-congolese	Congo- (Brazzaville)
british	United-Kingdom
british-virgin-islands	British-Virgin-Islands
brunei	Brunei
bruneian	Brunei
bulgaria	Bulgaria
bulgarian	Bulgaria
burkina	Burkina-Faso
burkina-faso	Burkina-Faso
burkinabe	Burkina-Faso
burma	Myanmar- (Burma)
burmese	Myanmar- (Burma)
burundi	Burundi
burundian	Burundi
cambodia	Cambodia
cambodian	Cambodia
cameroon	Cameroon
cameroonian	Cameroon
canada	Canada
canadian	Canada
cape-verde	Cape-Verde
cape-verdian	Cape-Verde
cayman	Cayman-Islands
cayman-islands	Cayman-Islands
central-african	Central-African-Republic
central-african-republic	Central-African-Republic
chad	Chad
chadian	Chad
chile	Chile

# Governing-term-7

chilean Chile  
 china China  
 chinese China  
 colombia Colombia  
 colombian Colombia  
 comoran Comoros  
 comoros Comoros  
 congo Congo- (Democratic-Republic)  
 congo- (brazzaville) Congo- (Brazzaville)  
 congo- (democratic-republic) Congo- (Democratic-Republic)  
 congo- (democratic-republic) Congo- (Democratic-Republic)  
 congolese Congo- (Democratic-Republic)  
 costa-rica Costa-Rica  
 costa-rican Costa-Rica  
 cote-d'ivoire Cote-d'Ivoire  
 cote-d'ivoire Cote-d'Ivoire  
 croatia Croatia  
 croatian Croatia  
 cuba Cuba  
 cuban Cuba  
 cypriot Cyprus  
 cyprus Cyprus  
 czech Czech-Republic  
 czech-republic Czech-Republic  
 czechoslovak Czech-Republic  
 czechoslovakian Czech-Republic  
 dane Denmark  
 danish Denmark  
 democratic-republic-of-the-congo Congo- (Democratic-Republic)  
 denmark Denmark  
 djibouti Djibouti  
 djiboutian Djibouti  
 dominican Dominican-Republic  
 dominican-republic Dominican-Republic  
 dutch Netherlands  
 east-timor East-Timor  
 ecuador Ecuador  
 ecuadorian Ecuador  
 egypt Egypt  
 egyptian Egypt  
 el-salvador El-Salvador  
 english United-Kingdom  
 englishman United-Kingdom  
 englishmen United-Kingdom  
 englishwoman United-Kingdom  
 englishwomen United-Kingdom  
 equatoguinean Equatorial-Guinea  
 equatorial-guinea Equatorial-Guinea  
 eritrea Eritrea  
 eritrean Eritrea  
 estonia Estonia  
 estonian Estonia  
 ethiopia Ethiopia  
 ethiopian Ethiopia  
 fiji Fiji  
 fijian Fiji  
 finland Finland  
 finnish Finland  
 france France  
 french France

# Gnemy-term-8

gabon	Gabon
gabonese	Gabon
gambian	The-Gambia
german	Germany
germany	Germany
ghana	Ghana
ghanaian	Ghana
greece	Greece
greece	Greece
greek	Greece
greenland	Greenland
greenlandic	Greenland
grenada	Grenada
grenadian	Grenada
guam	Guam
guaman	Guam
guatemala	Guatemala
guatemalan	Guatemala
guiana	Guiana
guianese	Guiana
guinea	Guinea
guinea-bissau	Guinea-Bissau
guinea-bissauan	Guinea-Bissau
guinean	Guinea
guyana	Guyana
guyanese	Guyana
haiti	Haiti
haittian	Haiti
hellenian	Greece
hercegovina	Bosnia-and-Hercegovina
honduran	Honduras
honduras	Honduras
hong-kong	Hong-Kong
hong-kongnese	Hong-Kong
hungarian	Hungary
hungary	Hungary
iceland	Iceland
icelander	Iceland
icelandic	Iceland
india	India
indian	India
indonesia	Indonesia
indonesian	Indonesia
iran	Iran
iranian	Iran
iraq	Iraq
iraqi	Iraq
ireland	Ireland
irish	Ireland
irishman	Ireland
irishwoman	Ireland
israel	Israel
israeli	Israel
italian	Italy
italy	Italy
ivorian	Ivory-Coast
ivory-coast	Ivory-Coast
jamaica	Jamaica
jamaican	Jamaica
japan	Japan

# Gavem-term-9

japanese	Japan
jordan	Jordan
jordanian	Jordan
kazak	Kazakhstan
kazakh	Kazakhstan
kazakhstan	Kazakhstan
kazakstan	Kazakhstan
kenya	Kenya
kenyan	Kenya
korean	South-Korea
kosovo	Bosnia-and-Hercegovina
kuwait	Kuwait
kuwaiti	Kuwait
kyrgyz	Kyrgyzstan
kyrgyzstan	Kyrgyzstan
laos	Laos
laotian	Laos
latvia	Latvia
latvian	Latvia
lebanese	Lebanon
lebanon	Lebanon
lesothian	Lesotho
lesotho	Lesotho
liberia	Liberia
liberian	Liberia
libya	Libya
libyan	Libya
liechtenstein	Liechtenstein
liechtensteiner	Liechtenstein
lithuania	Lithuania
lithuanian	Lithuania
luxembourg	Luxembourg
luxembourger	Luxembourg
lybia	Libya
lybian	Libya
macau	Macau
macauan	Macau
macedonia	Macedonia
macedonian	Macedonia
madagascan	Madagascar
madagascar	Madagascar
mahora	Mahora
mahoran	Mahora
malawi	Malawi
malawian	Malawi
malaysia	Malaysia
malaysian	Malaysia
maldives	Maldives
maldivian	Maldives
mali	Mali
malian	Mali
malta	Malta
maltese	Malta
marshall-islands	Marshall-Islands
marshalllese	Marshall-Islands
martiniquais	Martinique
martinique	Martinique
mauritania	Mauritania
mauritanian	Mauritania
mauritian	Mauritius

mauritius	Mauritius
mexican Mexico	
mexico Mexico	
moldavia	Moldova
moldavian	Moldova
moldova Moldova	
moldovan	Moldova
monacan Monaco	
monaco Monaco	
mongolia	Mongolia
mongolian	Mongolia
montenegro	Yugoslavia
montserrat	Montserrat
montserratian	Montserrat
moroccan	Morocco
morocco Morocco	
motswana	Botswana
motswanian	Botswana
mozambican	Mozambique
mozambique	Mozambique
myanmar- (burma)	Myanmar- (Burma)
namibia Namibia	
namibian	Namibia
nepal Nepal	
nepalese	Nepal
netherlands-antilles	Netherlands-Antilles
netherlands	Netherlands
new-caledonia	New-Caledonia
new-caledonian	New-Caledonia
new-zealand	New-Zealand
new-zealander	New-Zealand
nicaragua	Nicaragua
nicaraguan	Nicaragua
niger Niger	
nigeria Nigeria	
nigerian	Nigeria
nigerien	Niger
north-korea	North-Korea
north-korean	North-Korea
norway Norway	
norwegian	Norway
oman Oman	
omani Oman	
pacific-islander	Pacific-Islands
pacific-islands	Pacific-Islands
pakistan	Pakistan
pakistani	Pakistan
palestine	The-Occupied-Territories
palestinian	The-Occupied-Territories
panama Panama	
panamanian	Panama
papua-new-guinea	Papua-New-Guinea
papua-new-guinean	Papua-New-Guinea
papuan	Papua-New-Guinea
paraguay	Paraguay
paraguayan	Paraguay
peru Peru	
peruvian	Peru
philippine	Philippines
philippines	Philippines

philippino	Philippines
poland Poland	
polish Poland	
portugal	Portugal
portuguese	Portugal
puerto-rican	Puerto-Rico
puerto-rico	Puerto-Rico
qatar Qatar	
qatari Qatar	
romania Romania	
romanian	Romania
russia Russia	
russia Russia	
russian Russia	
russian-federation	Russia
rwanda Rwanda	
rwandan Rwanda	
saint-lucia	Saint-Lucia
saint-lucian	Saint-Lucia
salvadoran	El-Salvador
samoa Samoa	
samoan Samoa	
san-marino	San-Marino
sanmarinese	San-Marino
sao-tome-and-principe	Sao-Tome-and-Principe
sao-tomean	Sao-Tome-and-Principe
saudi Saudi-Arabia	
saudi-arabia	Saudi-Arabia
saudi-arabian	Saudi-Arabia
scotland	United-Kingdom
scottish	United-Kingdom
senegal Senegal	
senegalese	Senegal
serbia Yugoslavia	
serbia-montenegro	Yugoslavia
serbian Yugoslavia	
seychelles	Seychelles
seychellois	Seychelles
sierra-leone	Sierra-Leone
sierra-leonean	Sierra-Leone
singapore	Singapore
singaporean	Singapore
slovak Slovakia	
slovakia	Slovakia
slovakian	Slovakia
slovenia	Slovenia
slovenian	Slovenia
solomon-islander	Solomon-Islands
solomon-islands	Solomon-Islands
somali Somalia	
somalia Somalia	
south-africa	South-Africa
south-african	South-Africa
south-korea	South-Korea
south-korea	South-Korea
south-korean	South-Korea
soviet Russia	
soviet-union	Russia
spain Spain	
spaniard	Spain

spanish	Spain	
sri-lanka		Sri-Lanka
sri-lankan		Sri-Lanka
sudan	Sudan	
sudanese		Sudan
surinam	Suriname	
suriname		Suriname
surinamese		Suriname
swazi	Swaziland	
swaziland		Swaziland
swede	Sweden	
sweden	Sweden	
swedish	Sweden	
swiss	Switzerland	
switzerland		Switzerland
syria	Syria	
syrian	Syria	
taiwan	Taiwan	
taiwanese		Taiwan
tajik	Tajikistan	
tajiki	Tajikistan	
tajikistan		Tajikistan
tanzania		Tanzania
tanzanian		Tanzania
thai	Thailand	
thailand		Thailand
the US	US	
the USA	US	
the gambia		The-Gambia
the occupied-territories		The-Occupied-Territories
the-us	the-US	
the-usa	the-US	
timorese		East-Timor
togo	Togo	
togolese		Togo
tonga	Tonga	
tongan	Tonga	
trinidad		Trinidad-and-Tobago
trinidad-and-tobago		Trinidad-and-Tobago
trinidadian		Trinidad-and-Tobago
tunisia	Tunisia	
tunisian		Tunisia
turk	Turkey	
turk-islander		Turks-and-Caicos-Islands
turkey	Turkey	
turkish	Turkey	
turkmen	Turkmenistan	
turkmenistan		Turkmenistan
turks-and-caicos-islands		Turks-and-Caicos-Islands
u.k.	U.K.	
u.s.	US	
u.s.a.	US	
u.s.s.r.		U.S.S.R.
uganda	Uganda	
ugandan	Uganda	
uk	UK	
ukraine	Ukraine	
ukrainian		Ukraine
ukranian		Ukraine
united-kingdom		United-Kingdom

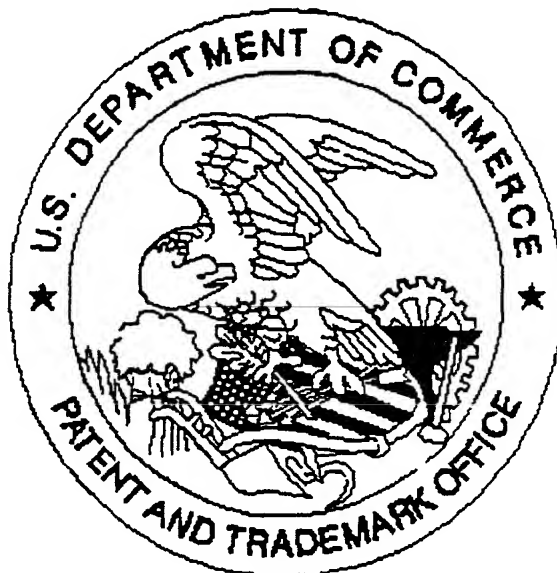


united-kingdom	United-Kingdom	
united-kingdom	United-Kingdom	
united-states	US	
united-states-of-america		US
united-states-of-america		US
uruguay	Uruguay	
uruguayan	Uruguay	
usa	US	
ussr	USSR	
uzbek	Uzbekistan	
uzbekistan	Uzbekistan	
vanuatu	Vanuatu	
vanuatuan	Vanuatu	
venezuela	Venezuela	
venezuelan	Venezuela	
vietnam	Vietnam	
vietnamese	Vietnam	
virgin-islander	British-Virgin-Islands	
west-samoan	Western-Samoa	
western-samoa	Western-Samoa	
yemen	Yemen	
yemeni	Yemen	
yugoslav	Yugoslavia	
yugoslavia	Yugoslavia	
yugoslavia	Yugoslavia	
yugoslavia	Yugoslavia	
yugoslavian	Yugoslavia	
zaire	Zaire	
zairean	Zaire	
zambia	Zambia	
zambian	Zambia	
zimbabwe	Zimbabwe	
zimbabwean	Zimbabwe	

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pages 19, 20, 21, 22, 23, 24,  
26, 27, are very dark